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REDUCING COSTS OF GRADING WOOL IN WAREHOUSES

U.S. DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Transportation and Facilities Research Division

PREFACE

The Agricultural Marketing Service, through its research program, studies facilities, equipment, and work methods involved in the marketing of agricultural products. The objective is increased marketing efficiency with resulting benefits to both producers and consumers. One area of the marketing research program deals with developing improved work methods and designing more efficient layouts for handling wool in warehouses. Grading wool is one of the handling operations that appeared to offer an opportunity for effecting savings. Other warehouse handling operations will be covered in future reports.

Few wool warehouses were planned and constructed with the benefits of technical assistance. Poorly arranged multistory warehouses have discouraged grading methods that use mechanized equipment. Thus, wool is graded in most warehouses primarily by manual methods with relatively high labor costs.

This report provides data and guidelines on the relative efficiency of certain methods of grading wool. Methods of grading consigned wool and warehouse-owned wool involve substantially different labor and equipment requirements and costs and are, therefore, analyzed separately.

Acknowledgment is made to the warehouse operators who made their facilities available for study.

The study was conducted under the general supervision of George E. Turner, marketing research analyst, Transportation and Facilities Research Division, Agricultural Marketing Service, U. S. Department of Agriculture.

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SUMMARY

Improved work methods and equipment can reduce costs for the grading operations in wool warehouses grading 1 million pounds annually by $1.44 per 1,000 pounds, when grading consigned wool, and $0.54 per 1,000 pounds when grading warehouse-owned wool. This is an annual saving of $1,440 and $540, respectively.

Total labor and equipment requirements and costs are compared for three observed methods and one suggested method of grading consigned wool and warehouse-owned wool. The methods are based on the number of workers and the type of equipment used.

Layouts for the various combinations of equipment types used in wool-grading methods are those using electric hoist and wool carts; conveyor and wool carts; and a conveyor system.

In grading consigned wool, the seven-worker, handtruck, hoist, and wool-cart method at $4.55 has the highest cost. This compares with $4 for the six-worker, handtruck, hoist, and wool-cart method; $3.80 for the five-worker, handtruck, hoist, and wool-cart method; and $3.11 for the five-worker, clamp-truck, conveyor, and wool-cart method. The latter cost is 32 percent less than with highest cost. The labor cost is reduced $1.63 per 1,000 pounds and the equipment cost is increased 19 cents. Labor-saving equipment and adjustments in work methods to minimize wait time permit the reduction in labor cost. Equipment costs increase because of the substitution of a clamp truck and conveyor for the handtruck and electric hoist.

Labor and equipment costs for grading warehouse-owned wool are: $3.19 for the six-worker, handtruck, hoist, and wool-cart method; $3.13 for the six-worker, clamp-truck, hoist, and wool-cart method; $3.10 for the four-worker, clamp-truck, and conveyor method; and $2.65 for the three-worker, clamp-truck and conveyor method. The lowest cost is about 17 percent less than the highest cost. The labor cost is reduced $1.64 per 1,000 pounds, and the equipment cost is increased $1.10. The lower labor cost and the higher equipment cost result from the use of relatively high-cost mechanized equipment.

REDUCING COSTS OF GRADING WOOL IN WAREHOUSES

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BACKGROUND OF THE STUDY

Attempts to produce large quantities of quality wool in this country began about 150 years ago, thereby creating a need for our present wool warehouse industry. In 1961, there were about 33 million sheep in the United States from which approximately 266 million pounds of wool were shorn. The sales value of this wool is estimated at $110 million. There were about 190 warehouses throughout the country handling consigned wool or wool purchased from the producer.

Most wool producers do not have the facilities for storing their wool clip for long periods. Wool warehouses provide this service, and many warehouses also buy and sell wool. Thus, wool warehouses process and store consigned wool and purchase, process, store, and sell warehouse-owned wool.

For many years, most of the operations in wool warehouses were performed primarily by manual methods. Many wool warehouses are outmoded multistory buildings, originally constructed for other purposes. Handling methods have been handicapped by lack of standardization of containers. Wool is received in bags of a variety of shapes and sizes. Occasionally, producers bring wool to the warehouse loaded into a farm truck without a container of any type. There is also considerable variation in the sizes and shapes of bags or bales in which wool is loaded out of the warehouse. These factors discourage the use of mechanized methods and lead to excessive labor costs. Few of these wool warehouses were planned and constructed with the benefits of technical assistance. As a result, the arrangement of component parts of most warehouses does not provide for a direct flow between major work areas, with a minimum of handling. Work stations are not always located to provide the shortest transporting distances in moving wool into, through, and out of the warehouse.

The methods used for grading wool reflect the general defects of overall warehouse planning and operations. Ungraded wool is often stored on two or more levels in the warehouse, necessitating excess handling and increased labor requirements. Many plants transport ungraded wool, one bag per trip, from the bagged wool storage area to the grading area with a 2-wheel handtruck. Typical methods of handling and emptying bags at the grading area and manually placing fleeces on the grading table are time-consuming and costly. The use of wool carts in grading warehouse-owned wool results in substantial job-regulated wait time and increased labor cost.

This research was undertaken to: Measure the relative efficiencies of various work methods and types and combinations of types of equipment used in grading wool; and develop layouts with equipment arranged for the various methods of grading wool.

Research Methods

Research on methods of grading wool was conducted in selected wool warehouses in Ohio, Indiana, Minnesota, Iowa, South Dakota, Montana, Wyoming, Colorado, and Missouri. Preliminary observations and studies were made in 17 warehouses to determine the methods and equipment used for grading. Time studies were made in 12 warehouses selected as representative of the various methods and equipment used for grading consigned and warehouse-owned wool.

Time studies were made to:

Determine the elapsed time required to perform operations;

Determine the total man- and machine-hours required;

Determine the location and extent of delays and the amount of other nonproductive time during operations; and

Provide a basis for developing improved work methods, grading area layout, and equipment arrangement.

There are many variations in the methods of grading in warehouses. This study, however, is limited to selected methods, crew sizes, and types of equipment, and is not intended to answer all problems or to cover all conditions existing in wool warehouses.

Cost Determinations

Labor costs are based on the productive labor required for the operation plus the amount of idle time inherent in the method. "Wait time," in this report, is always job-regulated. Equipment costs are allocated to each method on the basis of the elapsed time for the method for all equipment except the clamp truck. This truck is usually used part-time for other work while wool-grading operations are being performed. Thus, the cost of the clamp truck is allocated on the basis of the time actually used in the grading jobs. Labor and equipment requirements and costs are computed on a per 1,000-pound basis in a warehouse grading 1 million pounds annually.

In order to compute labor and equipment requirements and costs, it was necessary to make certain assumptions. The assumptions, based on analysis of collected data and discussions with warehouse personnel, are:

- The capacity of the warehouse is 1 million pounds of wool. Many warehouses grade less than one capacity turnover during the year; others grade more than 1.5 times capacity.

- Ungraded wool is received in bags averaging 120 pounds each. Bags are not standardized, and some were only partially filled. Observed weights ranged from about 50 pounds to almost 300 pounds.

- A wool fleece weighs an average of 8 pounds. This varies by section of the country and breed of sheep sheared.

- An owner's lot of consigned wool weighs 500 pounds. Warehouses serving large sheep ranches will average larger consignments and those serving small farm flocks will average less. Larger or smaller lot sizes would have considerable effect on grading costs.

- A wool cart transports an average of 50 pounds per trip when used in grading consigned wool, and an average of 140 pounds per trip when used in grading warehouse-owned wool. The reason for the difference is that in grading consigned wool, all carts with one or more fleeces must be weighed and emptied after each owner's lot, while carts of warehouse-owned wool are normally full when transported, without weighing, to the graded wool storage bins.

Another factor, beyond the scope of this study, which could materially affect costs, is quality variation in wool to be graded.

A wage rate of $1.25 per hour is assumed as the average rate for unskilled labor in a wool warehouse. Skilled labor is computed on the basis of $2 per hour. The wool grader is considered a skilled worker; all other workers in a crew are classified unskilled.

Data on equipment costs were obtained from manufacturers, dealers, and warehouse operators and are based on average factory prices for 1960 and 1961. Total equipment cost is the sum of ownership and operating costs (table 13, appendix); they are computed on an annual basis.

Ownership costs are considered to be fixed and include depreciation, interest, taxes, and insurance. Interest on the average investment is calculated at 6 percent, and 4 percent of the initial investment is allowed for insurance and taxes.

Operating costs include fuel, power, and maintenance. Operating cost computations are based on representative costs in wool warehouses.

OPERATIONS PERFORMED IN GRADING WOOL

In this study, grading includes:

Transporting bagged wool from storage area to grading area;

Empting wool bags and placing wool fleeces on grading table;

Grading wool fleeces; and

Transporting graded wool from grading area to storage bins.

All four operations are essential for grading wool, and all were observed in each warehouse studied. There were, however, substantial differences in the number of workers required and the type and amount of equipment used in performing the various operations. These differences, and the extent to which the four operations are coordinated to minimize job-regulated wait time, determine the relative efficiency of the wool-grading operations. Each of the four major operations is discussed separately on the basis of equipment types used in grading 1,000 pounds of wool.

Transporting Bagged Wool From Storage Area to Grading Area

Bags of wool are transported from the bagged wool storage to the grading area by use of a 2-wheel handtruck or a forklift truck with a clamp attachment.

Two-wheel handtruck.--One worker pushes the empty handtruck from the grading area to the bagged wool storage area, loads one bag onto the handtruck, moves the loaded handtruck to the location in the grading area used for opening and emptying wool bags, and unloads the bag of wool. An average transport distance of 70 feet was observed in the warehouses that were studied.

Clamp truck.--One worker drives the empty clamp truck from the grading area to the bagged-wool storage area, positions two bags of wool for pickup, picks up two bags (fig. 1), drives the loaded clamp truck to the location in the grading area used for opening and emptying wool bags, and unloads the two bags of wool.

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Figure 1.--Transporting bagged wool with a clamp truck.

The worker devotes only part time to this operation; he assembles several bags in the grading area, does other jobs such as receiving or loading out wool, and returns to this operation as needed.

Emptying Wool Bags and Placing Fleeces on Grading Table

Bags of fleeces are emptied onto the floor by an electric hoist and the fleeces are manually placed on the grading table (fig. 2), or the bags are manually emptied onto a conveyor leading to the grading table.

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Figure 2.--Grading individual wool fleeces.

Electric hoist.--Emptying wool fleeces from the bag with an electric hoist involves opening one end of the bag, lowering the hoist to bag level, attaching hoist clamps to the closed end of bag, raising the hoist until the open end of the bag is about 18 inches above floor level, and allowing fleeces to fall onto floor. Fleeces lodged in the bag are manually removed. A worker then lowers the hoist, detaches the hoist clamps from the empty bag, raises the hoist so that it will not interfere with the work, folds the empty bag and places it in a stack near the area. Another worker picks up fleeces and places them on the grading table.

This operation is usually performed by two workers. One worker empties the bag of wool and the other places the wool fleeces on the grading table. The productive labor required to perform the operation is 0.61 man-hour per 1,000 pounds of wool.

Conveyor.--To empty wool fleeces from the bag onto a conveyor leading to the grading table, the entire length of one side of the bag is opened, and the fleeces are placed on the conveyor. The empty bag is folded and stacked. The conveyor carries the fleeces to the grading table (fig. 3).

Generally, two workers perform this operation.

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Figure 3.--Wool fleeces moving to the grading table by a conveyor

Grading Wool Fleeces

One worker grades wool by picking up an individual fleece, visually determining its grade (fig. 2), and tossing the fleece into the appropriate wool cart or belt conveyor. He records the necessary information on the tally sheet; this includes ownership of the wool, amount of wool in the lot, the condition of the wool, and any other data that management may request. The grader also assists in cleanup around the grading area after each owner's lot has been graded.

Transporting Graded Wool From Grading Area to Graded-Wool Storage Bins

Graded wool is transported from the grading area to the storage bins by wool carts or a system of conveyors. Consigned wool, which must be weighed en route to the storage bins, is loaded in carts. Warehouses handling both consigned and warehouse-owned wool also use carts. Only those warehouses handling their own wool (with no graded weights required) can use the system of conveyors leading from the grading area to the bins.

Wool carts.--Two workers transport graded wool from the grading area to the storage bins by wool carts. They push the wool cart to the platform scale (for consigned wool), position the cart on the scale, make weight determinations and recordings, push the cart from the scale to the appropriate graded wool bin, remove fleeces from the cart and toss them into the bin, and return the empty cart to the grading area.

A cart carries wool of only one grade at a time. Studies made at the weighing station and the weight data records show that an average of about 50 pounds of wool is carried to the storage bins per trip. Thus, 20 trips are required to transport 1,000 pounds.

Warehouse-owned wool generally is not weighed en route to the storage bins. The warehouse management occasionally may ask that certain purchased lots of wool be weighed by grades as a check on the buyer's judgment or for other reasons. Warehouse-owned wool is transported to storage bins in loads averaging about 140 pounds; seven trips are required to transport 1,000 pounds.

Conveyors.--No labor is required when wool is transported from the grading table to the bins by a system of conveyors. The final step in the grading operation is tossing each graded fleece onto the appropriate conveyor. A separate conveyor leads to each bin.

METHODS USED IN GRADING WOOL

Various crew sizes, types of equipment, and assignments are combined to show eight methods that may be used for grading wool in warehouses. Four of the grading methods apply to consigned wool and four to warehouse-owned wool. In each case three of the four methods are typical observed methods and the fourth is a suggested method. Consigned and warehouse-owned wool are discussed separately because the work methods are different, and costs are not comparable for the two groups.

Generally, the efficiency with which grading wool is performed by any of the methods depends on how effectively the four major operations can be coordinated. Because operations are sequential, jobs usually cannot be allocated so that the labor requirements for each worker are the same.

Labor and equipment costs by various methods and the labor requirements for transporting bagged and graded wool specific distances by transporting equipment are shown in appendix tables 13 through 17. All methods are for grading 1,000 pounds of wool.

Grading Consigned Wool

The four methods of grading consigned wool are: (1) Seven-worker, handtruck, hoist, and wool cart (called the seven-worker method in this section); (2) six-worker, handtruck, hoist, and wool cart (the six-worker method); (3) five-worker handtruck, hoist, and wool cart (five-worker method); and (4) five-worker clamp truck, conveyor, and wool cart (five-worker clamp truck method). The first three methods use identical equipment; however, the crew sizes and the work assignments are different. The fourth method is the suggested method and requires relatively high-cost equipment which substantially reduces the total labor requirement for grading wool.

Seven Workers, Handtruck, Hoist, and Wool Cart

Table 1 shows the labor requirements and cost for grading wool by this method. One worker, using a handtruck, transports bagged wool from the bagged wool storage area to the bag-emptying point in the grading area; one worker handles and empties the bags of wool; one worker places fleeces on the grading table; one worker grades the individual fleeces; two workers using carts transport the wool from the grading area to the storage bins; and one worker makes weight determinations and recordings.

The worker grading fleeces is the pace setter for all other workers in the crew. The grader requires 0.44 hour per 1,000 pounds of wool to grade, maintain the tally sheet, and clean up the area after each owner's lot. The other six workers in the crew have varying amounts of wait time.

The equipment requirements and costs are based on the use of a 2-wheel handtruck and an electric hoist (fig. 4), a grading table, a platform scale (fig. 5), and 18 wool carts for 0.44 hour each or a total of 2.20 machine-hours. The equipment cost is 37 cents.

The total labor and equipment cost for grading 1,000 pounds of wool is $4.55.

Six Workers, Handtruck, Hoist, and Wool Cart

The labor requirements and cost for the six-worker method are shown in table 2. The major difference between this method and the seven-worker method is that the two workers transporting graded wool in carts from the grading area to the storage bins make the weight determination and recordings. This method does not require a full-time worker for weighing and recording weight data. The worker grading fleeces is the pace setter. The other five workers each have wait time.

Table 1.--Labor requirements and costs for a 7-man crew to grade 1,000 pounds of consigned wool by the handtruck, hoist, and wool-cart method

Operation	Labor requirements and costs			
	Productive labor	Wait time	Total labor	Cost
	Man-hours	Man-hours	Man-hours	Dollars
Transporting bagged wool from storage to grading area (average distance 70 feet)	0.20	0.24	0.44	0.55
Emptying wool bags and placing fleeces on grading table	.61	.27	.88	1.10
Grading fleeces	.44	--	.44	.88
Transporting graded wool to storage bins (average distance 65 feet)	.72	.60	1/1.32	1.65
Total	1.97	1.11	3.08	4.18

Elapsed time.....0.44 hour

1/ The worker making weight determinations and recordings has 0.18 man-hour of productive labor and 0.26 man-hour of wait time. The two workers transporting carts have 0.54 man-hour of productive labor and 0.34 man-hour of wait time.

Figure 4.--Electric hoist holding bag for emptying. Two-wheel handtruck is at right.

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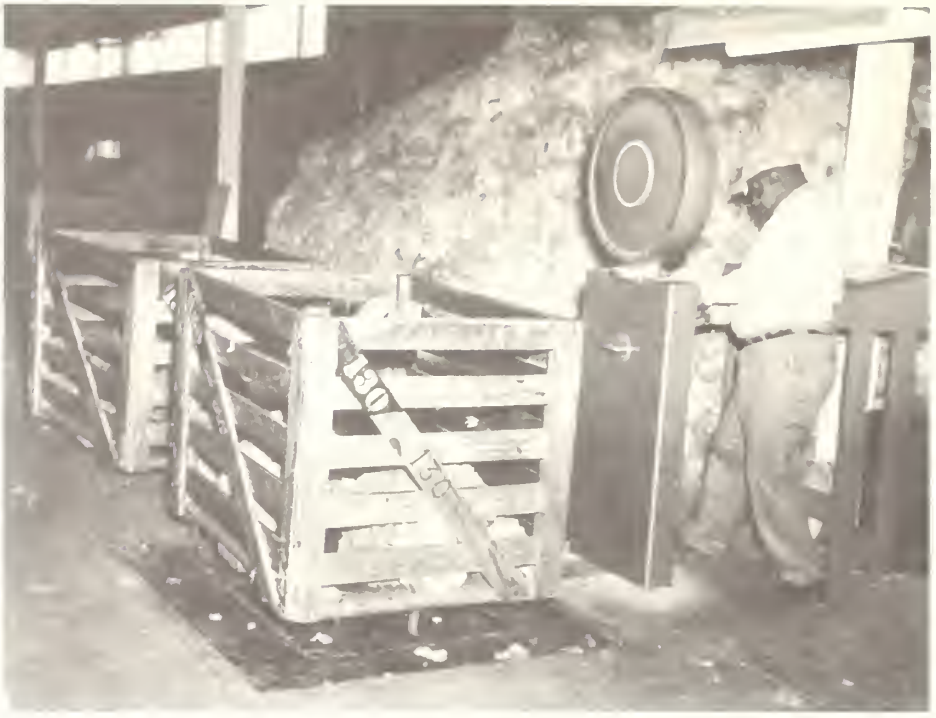

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Figure 5.--Weighing graded fleeces in a wool cart on the way to storage bins.

Table 2.--Labor requirements and costs for a 6-man crew to grade 1,000 pounds of consigned wool by the handtruck, hoist, and wool-cart method

Operation	Labor requirements and costs			
	Productive labor	Wait time	Total labor	Cost
	Man-hours	Man-hours	Man-hours	Dollars
Transporting bagged wool from storage to grading area (average distance 70 feet)	0.20	0.24	0.44	0.55
Emptying wool bags and placing fleeces on grading table	.61	.27	.88	1.10
Grading fleeces	.44	0	.44	.88
Transporting graded wool to storage bins (average distance 65 feet)	.72	.16	.88	1.10
Total	1.97	.67	2.64	3.63

Elapsed time.....0.44 hour

The equipment requirements and costs of this method are based on the use of a 2-wheel handtruck, an electric hoist, a grading table, a platform scale, and 18 wool carts for 0.44 hour each or a total of 2.20 machine-hours. The equipment cost is 37 cents. The total labor and equipment cost, by the six-worker method, is $4.

Five Workers, Handtruck, Hoist, and Wool Cart

Table 3 shows the labor requirements and cost for the five-worker method. A sketch of this method is shown in figure 6. One worker transports bags of wool from the bagged wool storage area to the grading area, opens one end of the bag, and uses the hoist to raise the bag for emptying; a second worker empties the bag, disposes of it, and places fleeces on the grading table; a third worker grades fleeces and tosses them into the appropriate cart; and two other workers transport the carts to the platform scale, weigh and record weights, and transport the carts to the storage bins, empty the carts, and return to the grading area.

The worker emptying bags and placing wool fleeces on the grading table is the pace setter. The other four workers each have job-regulated wait time.

Table 3.--Labor requirements and cost for a 5-man crew to grade 1,000 pounds of consigned wool by the handtruck, hoist, and wool-cart method

Operation	Labor requirements and costs			
	Productive labor	Wait time	Total labor	Cost
	Man-hours	Man-hours	Man-hours	Dollars
Transporting bagged wool from storage to grading area (average distance 70 feet)	0.32	0.17	0.49	0.61
Emptying wool bags and placing fleeces on grading table	.49	0	.49	.61
Grading fleeces	.44	.05	.49	.98
Transporting graded wool to storage bins (average distance 65 feet)	.72	.26	.98	1.22
Total	1.97	.48	2.45	3.43

Elapsed time.....0.49 hour

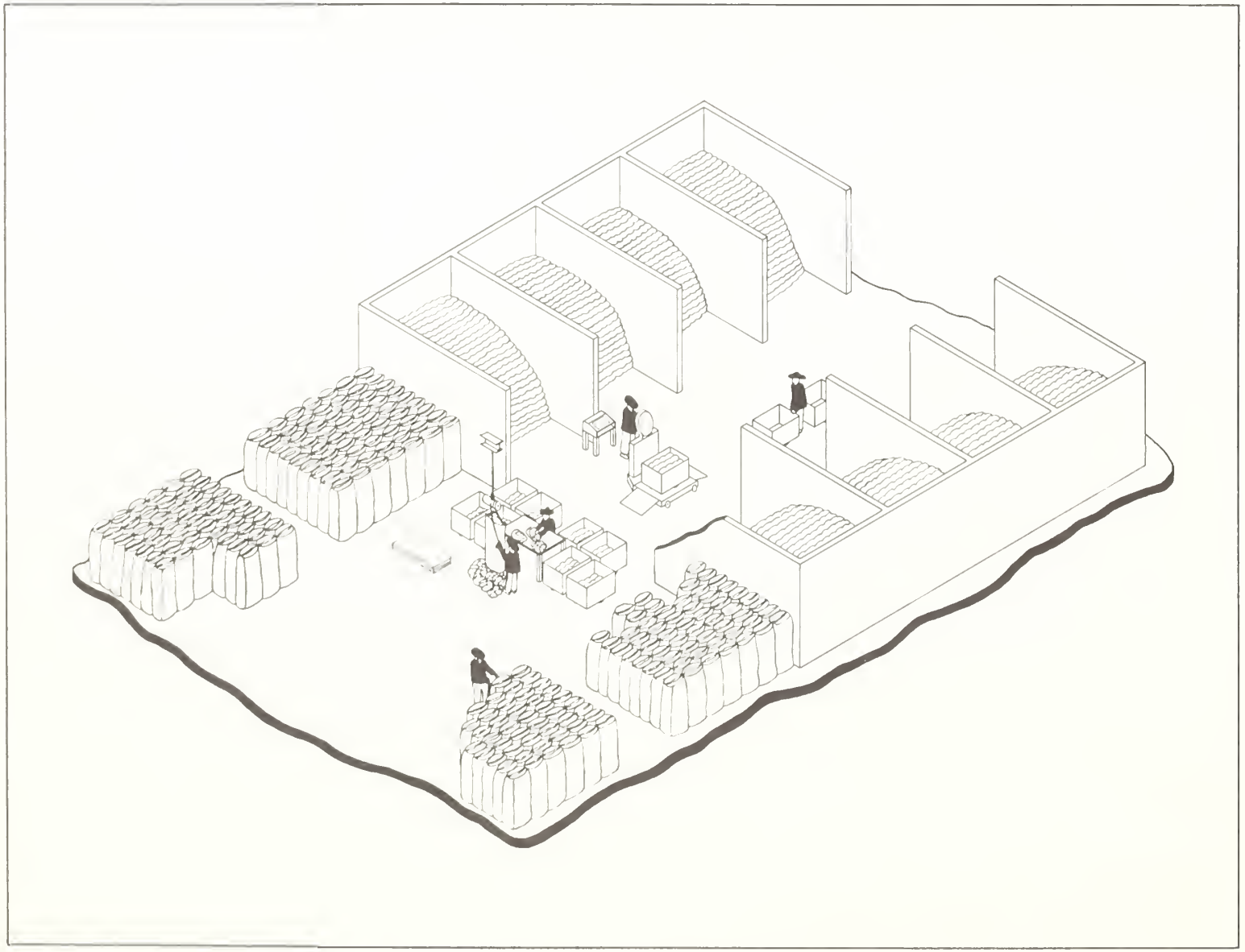

Figure 6.--Grading consigned wool by the five-worker, handtruck, hoist, and wool cart method.

The equipment is the same as for the seven-worker method, but requirements and costs are based on equipment use for 0.49 hour each or a total of 2.45 machine-hours. The equipment cost again is 37 cents.

The total labor and equipment cost for grading 1,000 pounds of wool by the five-worker, handtruck, hoist, and wool cart method is $3.80.

Five Workers, Clamp Truck, Conveyor, and Wool Cart

The labor requirements and cost for the five-worker clamp-truck method are shown in table 4. A sketch of this method is shown in figure 7. This is the suggested method for grading consigned wool. One worker transports bags of wool by clamp truck from the bagged wool storage area to the grading area. The clamp-truck operator also performs other transporting work, such as receiving or loading out wool, while wool is being graded; therefore, only the portion of his time actually used for grading is charged to the operation. Another worker handles wool bags and places fleeces onto the conveyor leading to the grading table; one worker grades fleeces and tosses them into the appropriate cart; and two workers transport wool to the platform scale, weigh, record data, and put wool in the graded-wool bins.

Table 4.--Labor requirements and cost for a 5-man crew to grade 1,000 pounds of consigned wool by the clamp-truck, conveyor, and wool-cart method

Operation	Labor requirements and cost			
	Productive labor	Wait time	Total labor	Cost
	Man-hours	Man-hours	Man-hours	Dollars
Transporting bagged wool from storage to grading area (average distance 50 feet)	0.11	1/	0.11	0.14
Emptying wool bags and placing fleeces on grading table	.26	0.16	.42	.52
Grading fleeces	.42	0	.42	.84
Transporting graded wool to storage bins (average distance 60 feet)	.68	.16	.84	1.05
Total	1.47	.32	1.79	2.55

Elapsed time.....0.42 hour

1/ The clamp-truck operator is a part-time worker in this operation, and his time is charged on an actual use basis.

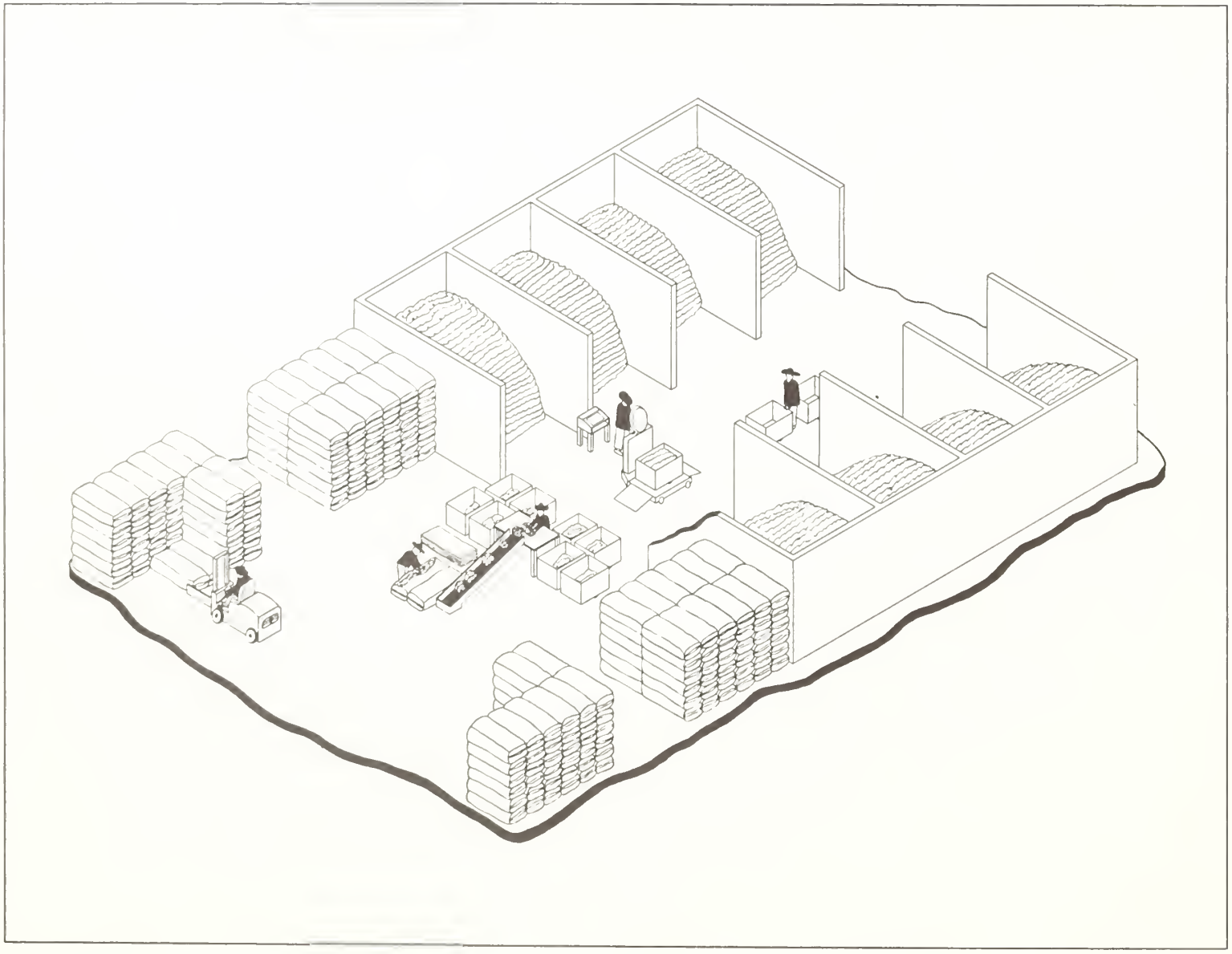

Figure 7.--Grading consigned wool by the five-worker, clamp-truck, conveyor, and wool-cart method.

The worker grading fleeces paces the operation. All other workers in the crew, except the clamp-truck operator, have wait time. The elapsed time, based on the requirements of the pace setter, is 0.42 hour. The grader requires 0.02 hour less time by this method than in others, because he does not clean up around the grading table. This work is done by the worker who loads fleeces onto the conveyor.

The equipment requirements and costs are based on the use of a clamp truck for 0.11 hour, and a conveyor, grading table, platform scale, and 14 wool carts for 0.42 hour each, for a total of 1.79 machine-hours. The equipment cost is 56 cents.

The total labor and equipment cost for grading 1,000 pounds of wool by the five-worker clamp-truck method is $3.11.

Comparison of Methods for Grading Consigned Wool

The labor and equipment requirements and costs per 1,000 pounds for grading consigned wool by all four methods are shown in table 5. The three methods using a handtruck and an electric hoist are primarily manual; labor accounts for more than 90 percent of the total cost in each case. The fourth method, that uses a forklift clamp truck and a grading table with a belt conveyor attached, substantially reduces labor cost, and only moderately increases equipment cost.

Table 5.--Labor and equipment requirements and costs for grading 1,000 pounds of consigned wool

Method	Requirements		Costs		
	Labor	Equipment	Labor	Equipment	Total
	Man-hours	Machine-hours	Dollars	Dollars	Dollars
Seven-worker, handtruck, hoist, and wool cart	3.08	2.20	4.18	0.37	4.55
Six-worker, handtruck, hoist, and wool cart	2.64	2.20	3.63	.37	4.00
Five-worker, handtruck, hoist and wool cart	2.45	2.45	3.43	.37	3.80
Five-worker, clamp truck, conveyor, and wool cart	1.79	1.79	2.55	.56	3.11

Operations performed in grading wool are sequential: Each can begin only when all or a substantial portion of the preceding operation has been completed. Because only one worker in a crew is normally used for grading wool fleeces (and this is a skilled worker with a high wage rate), the minimum number of additional workers that will keep the grader fully employed is the most efficient crew size. Thus the methods using six and seven workers have a relatively large amount of wait time and cost more.

Table 6.--Labor and equipment costs per 1,000 pounds for grading consigned wool, for different volumes

Wool volume (pounds per year)	Seven-worker, handtruck, hoist, and wool-cart method			Six-worker, handtruck, hoist, and wool-cart method			Five-worker, handtruck, hoist, and wool-cart method			Five-worker, clamp truck, conveyor and wool-cart method		
	Labor	Equipment	Total	Labor	Equipment	Total	Labor	Equipment	Total	Labor	Equipment	Total
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
250,000	4.18	1.42	5.60	3.63	1.42	5.05	3.43	1.42	4.85	2.55	2.00	4.55
500,000	4.18	.72	4.90	3.63	.72	4.35	3.43	.72	4.15	2.55	1.04	3.59
750,000	4.18	.48	4.66	3.63	.48	4.11	3.43	.48	3.91	2.55	.72	3.27
1,000,000	4.18	.37	4.55	3.63	.37	4.00	3.43	.37	3.80	2.55	.56	3.11
1,250,000	4.18	.30	4.48	3.63	.30	3.93	3.43	.30	3.73	2.55	.46	3.01
1,500,000	4.18	.25	4.43	3.63	.25	3.88	3.43	.25	3.68	2.55	.40	2.95
1,750,000	4.18	.22	4.40	3.63	.22	3.85	3.43	.22	3.65	2.55	.35	2.90
2,000,000	4.18	.19	4.37	3.63	.19	3.82	3.43	.19	3.62	2.55	.32	2.87

The highest cost method studied was the seven-worker method with a total labor and equipment cost of $4.55. The cost of the six-worker method was $4 and the cost of the five-worker method was $3.80. The lowest cost of the four methods of grading consigned wool was for the five-worker clamp-truck method with a total labor and equipment cost of $3.11. This method is $1.44, or about 32 percent, less than the highest cost method. The labor cost is reduced $1.63 per 1,000 pounds and the equipment cost is increased 19 cents. The reduction in labor cost is due to fewer workers in the crew, and minimizing wait time by slight adjustments in work assignments. Substituting a clamp truck and a conveyor for the handtruck and electric hoist increases equipment costs.

Table 6 shows computed labor and equipment costs, by volume, for grading 1,000 pounds of consigned wool in warehouses grading from 250,000 to 2 million pounds annually. These data do not include idle time for workers during slack times or off-seasons of the year. The four methods maintain the same relative cost position at all volumes within the range shown; the five-worker clamp-truck method has the lowest cost. The unit cost decreases as volume increases regardless of the grading method used.

Grading Warehouse-Owned Wool

The four methods of grading warehouse-owned wool are by:

- Six-worker, handtruck, hoist, and wool cart (called the six-worker method in this section);
- Six-worker, clamp truck, hoist, and wool cart (the six-worker clamp-truck method);
- Four-worker, clamp truck and conveyor (the four-worker method);
- Three-worker, clamp truck and conveyor (three-worker method).

In grading warehouse-owned wool, it is not necessary for the grader to maintain a tally sheet, or for the cart men to weigh the wool. This permits the use of a system of conveyors to transport graded wool directly from the table into the storage bins. When a system of conveyors is used, the grading table should be located as near the bins as is practical, to minimize conveyor lengths and costs. Generally, this location of the table results in a longer average distance for transporting bagged wool from storage to the grading area.

Six Workers, Handtruck, Hoist, and Wool Cart

The labor requirements and costs for grading 1,000 pounds of warehouse-owned wool by the six-worker method are shown in table 7. The worker grading fleeces is the pace setter.

The equipment requirements and costs are based on the use of a 2-wheel handtruck, an electric hoist, a grading table, and 18 wool carts for 0.36 hour each, for a total of 1.44 machine-hours. The equipment cost is 22 cents.

The total labor and equipment cost for grading 1,000 pounds of wool by the six-worker method is $3.19.

Table 7.--Labor requirements and costs for a 6-man crew to grade 1,000 pounds of wool by the handtruck, hoist, and wool-cart method

Operation	Labor requirements and costs			
	Productive labor	Wait time	Total labor	Cost
	Man-hours	Man-hours	Man-hours	Dollars
Transporting bagged wool from storage to grading area (average distance 70 feet)	0.20	0.16	0.36	0.45
Emptying wool bags and placing fleeces on grading table	.59	.13	.72	.90
Grading fleeces	.36	0	.36	.72
Transporting graded wool to storage bins (average distance 65 feet)	.32	.40	.72	.90
Total	1.47	.69	2.16	2.97
Elapsed time				0.36 hour

Six Workers, Clamp Truck, Hoist, and Wool Cart

Table 8 shows the labor requirements and costs for grading 1,000 pounds of warehouse-owned wool by the six-worker clamp-truck method. One worker transports bags of wool with a clamp truck from the bagged wool storage area to the grading area. Another worker handles and empties the bags; another worker places wool fleeces on the grading table. The grader grades the individual fleeces, and two workers transport the wool in carts to the storage bins, empty wool into the bins (figs. 8 and 9), and return empty carts to the grading area. The grader is the pace setter.

The equipment requirements and costs are based on the use of a clamp truck for 0.13 hour, an electric hoist, a grading table, and 18 wool carts for 0.36 hour each, for a total of 1.21 machine-hours. The equipment cost is 45 cents.

The total labor and equipment cost for grading 1,000 pounds of wool by the six-worker clamp-truck method is $3.13.

Table 8.--Labor requirements and costs for a 6-man crew to grade 1,000 pounds of warehouse-owned wool by the six-worker clamp-truck method, by operation

Operation	Labor requirements and costs			
	Productive labor	Wait time	Total labor	Cost
	Man-hours	Man-hours	Man-hours	Dollars
Transporting bagged wool from storage to grading area (average distance 70 feet)	0.13	1/	0.13	0.16
Emptying wool bags and placing fleeces on grading table	.59	0.13	.72	.90
Grading fleeces	.36	0	.36	.72
Transporting graded wool to storage bins (average distance 65 feet)	.32	.40	.72	.90
Total	1.40	.53	1.93	2.68

Elapsed time.....0.36 hour

1/ The clamp-truck operator is a part-time worker in this operation, and his time is charged on an actual-use basis.

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Figure 8.--Putting graded fleece in a graded-wool storage bin.

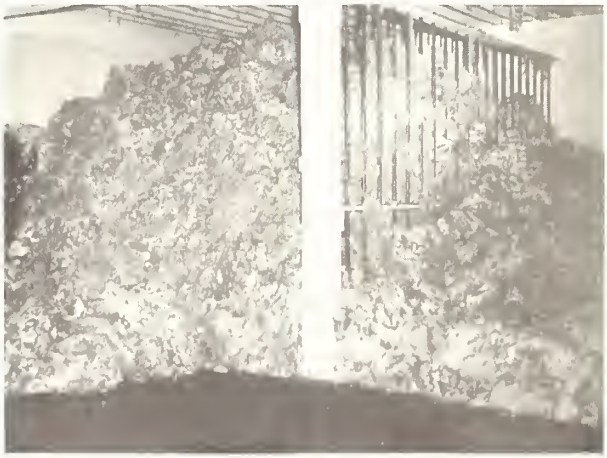

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Figure 9.--Wool fleeces in graded-wool storage bins.

Four Workers, Clamp Truck, and Conveyor

The labor requirements and costs for grading wool by the four-worker, clamp-truck,and conveyor method are shown in table 9. One worker, a part-time clamp-truck operator, transports bags of wool from their storage area to the lower end of the conveyor leading to the grading table. The lower end of the conveyor is below floor level for easy dumping of wool fleeces onto it, and slants upward so that wool fleeces are fed onto the grading table. Two workers handle bags and place wool fleeces on the conveyor.

Table 9.--Labor requirements and costs for a 4-worker crew to grade 1,000 pounds of warehouse-owned wool by the clamp-truck and conveyor method

Operation	Labor requirements and costs			
	Productive labor	Wait time	Total labor	Cost
	Man-hours	Man-hours	Man-hours	Dollars
Transporting bagged wool from storage to grading area (average distance 100 feet)	0.13	1/	0.13	0.16
Emptying wool bags and placing fleeces on grading table	.22	0.50	.72	.90
Grading fleeces	.36	0	.36	.72
Transporting graded wool to storage bins (average distance 30 feet)	0	0	0	0
Total	0.71	0.50	1.21	1.78
Elapsed time				0.36 hour

1/ The clamp-truck operator is a part-time worker in this operation and his time is charged on an actual-use basis.

The grader starts and stops this conveyor by a knee-operated control button, and thereby regulates the flow of fleeces onto the table for grading. After grading each wool fleece he tosses it onto the conveyor leading to the appropriate storage bin. No workers are required for transporting wool from the grading table to the bins. A system of these belt conveyors extends from the grading table over the top of the nearest wall of each bin (fig. 10). The number of conveyors needed would vary from area to area, depending on wool variation or the number of grades usually handled in that area. In this study, a system of seven conveyors was assumed as a basis for computing labor and equipment requirements and costs. The small amount of warehouse-owned wool that does not meet the grade standards is tossed into containers near the grading table. The amount of "offgrade" wool observed during this study was negligible, and its disposal was not included in the labor requirements.

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Figure 10.--A system of conveyors for moving fleeces from the grading table to the graded wool storage bins.

The equipment requirements and costs are based on the use of a clamp truck for 0.13 hour, a conveyor leading to the grading table, a grading table, and a system of conveyors leading to the graded wool storage bins for 0.36 hour each, for a total of 1.21 machine-hours. The equipment cost is $1.32.

The total labor and equipment cost for grading 1,000 pounds of wool by the four-worker, clamp-truck, and conveyor method is $3.10.

Three Workers, Clamp Truck, and Conveyor

Table 10 shows the labor requirements and costs for the three-worker method. This is the suggested method for grading warehouse-owned wool, (fig. 11). The operations are performed in the same manner as the four-worker method except that one worker instead of two handles bags and places fleeces on the conveyor leading to the grading table. The grader paces the crew.

The equipment requirements and costs are based on the use of a clamp truck for 0.13 hour, a conveyor leading to the grading table, a grading table, and conveyors leading to the storage bins for 0.36 hour each, for a total of 1.21 machine-hours. The equipment cost is $1.32.

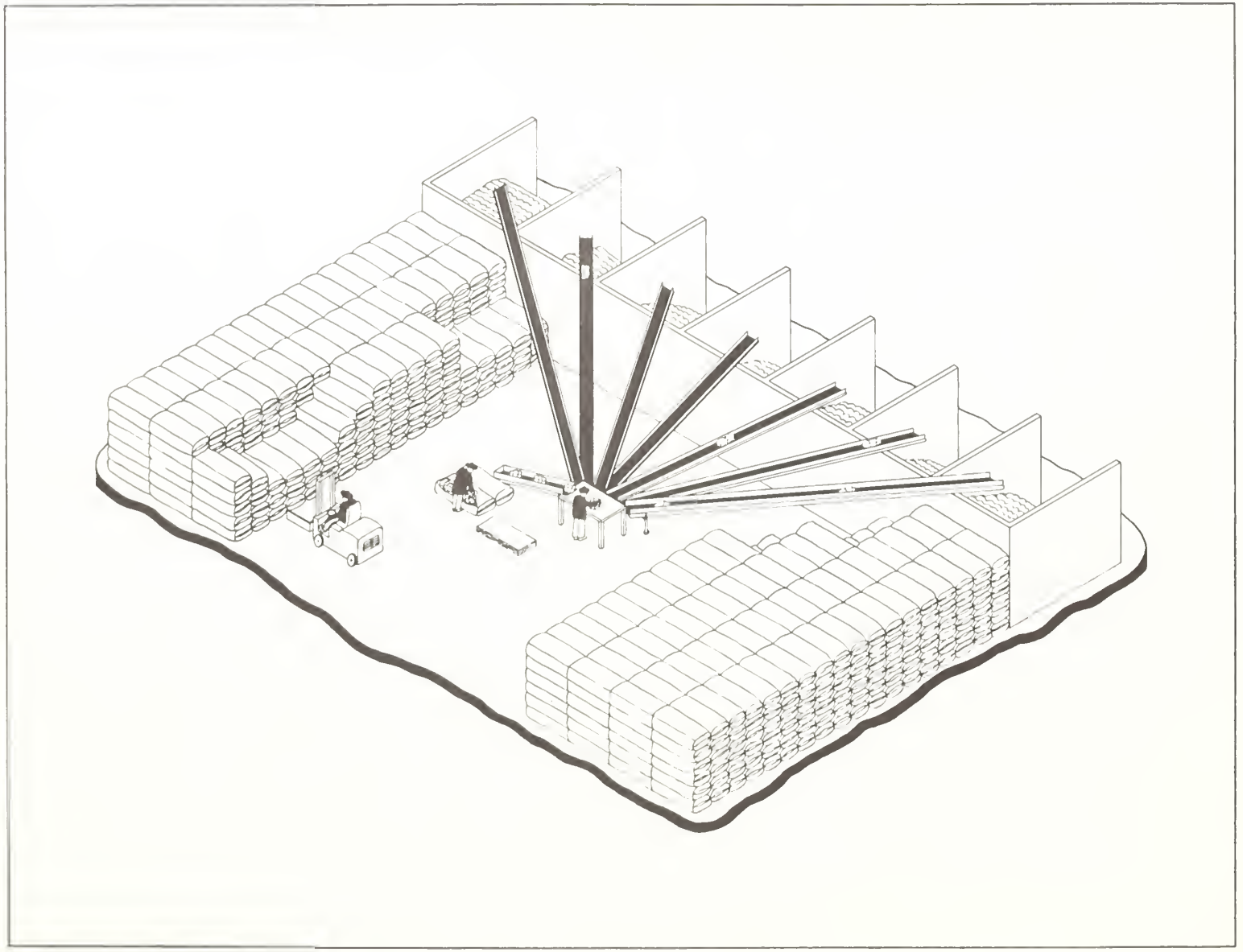

Figure 11.--Grading warehouse-owned wool by the three-worker, clamp-truck, and conveyor method.

Table 10.--Labor requirements and costs for a 3-man crew to grade 1,000 pounds of warehouse-owned wool by the clamp-truck and conveyor method

Operation	Labor requirements and costs			
	Productive labor	Wait time	Total labor	Cost
	Man-hours	Man-hours	Man-hours	Dollars
Transporting bagged wool from storage to grading area (average distance 75 feet)	0.13	1/	0.13	0.16
Emptying wool bags and placing fleeces on grading table	.22	0.14	.36	.45
Grading fleeces	.36	0	.36	.72
Transporting graded wool to storage bins (average distance 30 feet)	0	0	0	0
Total	0.71	0.14	0.85	1.33

Elapsed time.....0.36 hour

1/ The clamp-truck operator is a part-time worker in this operation and his time is charged on an actual-use basis.

The total labor and equipment costs for grading 1,000 pounds of wool by the three-worker, clamp-truck, and conveyor method are $2.65.

Comparison of Methods for Grading Warehouse-Owned Wool

The labor and equipment requirements and costs per 1,000 pounds for grading warehouse-owned wool are shown in table 11.

The highest cost method for grading 1,000 pounds of warehouse-owned wool is the six-worker method with a total labor and equipment cost of $3.19. The six-worker clamp-truck method incurs a total cost of $3.13, or a reduction of 6 cents per 1,000 pounds. These two methods are primarily manual; labor accounts for roughly 90 percent of the cost for both methods.

The four-worker and the three-worker methods use mechanized equipment to reduce labor requirements. The four-worker method has a total labor and equipment cost of $3.10; the cost of the three-worker method is $2.65. The relatively high equipment cost of $1.32 of these methods is due to the cost of a clamp truck and conveyor system.

The lowest cost three-worker method is 54 cents, or about 17 percent, less than the highest cost method. The labor cost is reduced $1.64 per 1,000 pounds and the equipment cost is increased $1.10. The reduction in labor is due to

fewer workers in the crew and less wait time. The reason for the increase in equipment cost is the same as that for the four-worker method.

Table 11.--Labor and equipment requirements and costs for grading 1,000 pounds of warehouse-owned wool

Method	Requirements		Costs		
	Labor	Equipment	Labor	Equipment	Total
	Man-hours	Machine-hours	Dollars	Dollars	Dollars
Six-worker, handtruck, hoist, and wool cart	2.16	1.44	2.97	0.22	3.19
Six-worker, clamp-truck, hoist, and wool cart	1.93	1.21	2.68	.45	3.13
Four-worker, clamp-truck, and conveyor	1.21	1.21	1.78	1.32	3.10
Three-worker, clamp-truck, and conveyor	.85	1.21	1.33	1.32	2.65

Table 12 shows labor and equipment costs by volume in warehouses grading from 250,000 pounds to 2 million annually. For warehouses grading up to 500,000 pounds annually, the six-worker method is the lowest cost method. Warehouses with annual volumes of 750,000 pounds or more have the lowest cost with the three-worker method.

SUGGESTED LAYOUTS FOR GRADING WOOL IN WAREHOUSES

In developing layouts for the grading area of a wool warehouse, the major factors to be considered are space and the movement of wool through the area. Suggestions for efficiency in the operation are described below.

The grading area is near both the bagged-wool storage and the graded-wool bins. The grading table is the focal point of the grading operation and is readily accessible to the worker transporting ungraded wool from storage and the workers transporting graded wool to the bins. Adequate space is provided for the grading operations; however, the location and arrangement of equipment are planned so that grading does not interfere with other warehouse operations.

Three layouts for different methods and equipment are described for electric hoist and wool carts; conveyor and wool carts; and a conveyor system.

Layout Using Electric Hoist and Wool Carts

The items of equipment in this layout (fig. 12) are:

- A transporting vehicle--a 2-wheel handtruck or a clamp truck;
- An electric hoist for emptying bags of wool;
- A grading table;

Table 12.--Labor and equipment costs per 1,000 pounds for grading warehouse-owned wool for different volumes

Wool volume (pounds per year)	Six-worker, handtruck, hoist, and wool-cart method			Six-worker, clamp truck, hoist, and wool-cart method			Four-worker, clamp truck and conveyor method			Three-worker, clamp truck, and conveyor method		
	Labor	Equipment	Total	Labor	Equipment	Total	Labor	Equipment	Total	Labor	Equipment	Total
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
250,000	2.97	0.84	3.81	2.68	1.60	4.28	1.78	4.56	6.34	1.33	4.56	5.89
500,000	2.97	.43	3.40	2.68	.84	3.52	1.78	2.40	4.18	1.33	2.40	3.73
750,000	2.97	.29	3.26	2.68	.58	3.26	1.78	1.68	3.46	1.33	1.68	3.01
1,000,000	2.97	.22	3.19	2.68	.45	3.13	1.78	1.32	3.10	1.33	1.32	2.65
1,250,000	2.97	.18	3.15	2.68	.38	3.06	1.78	1.10	2.88	1.33	1.10	2.43
1,500,000	2.97	.15	3.12	2.68	.32	3.00	1.78	.96	2.74	1.33	.96	2.29
1,750,000	2.97	.13	3.10	2.68	.29	2.97	1.78	.86	2.64	1.33	.86	2.19
2,000,000	2.97	.12	3.09	2.68	.26	2.94	1.78	.78	2.56	1.33	.78	2.11

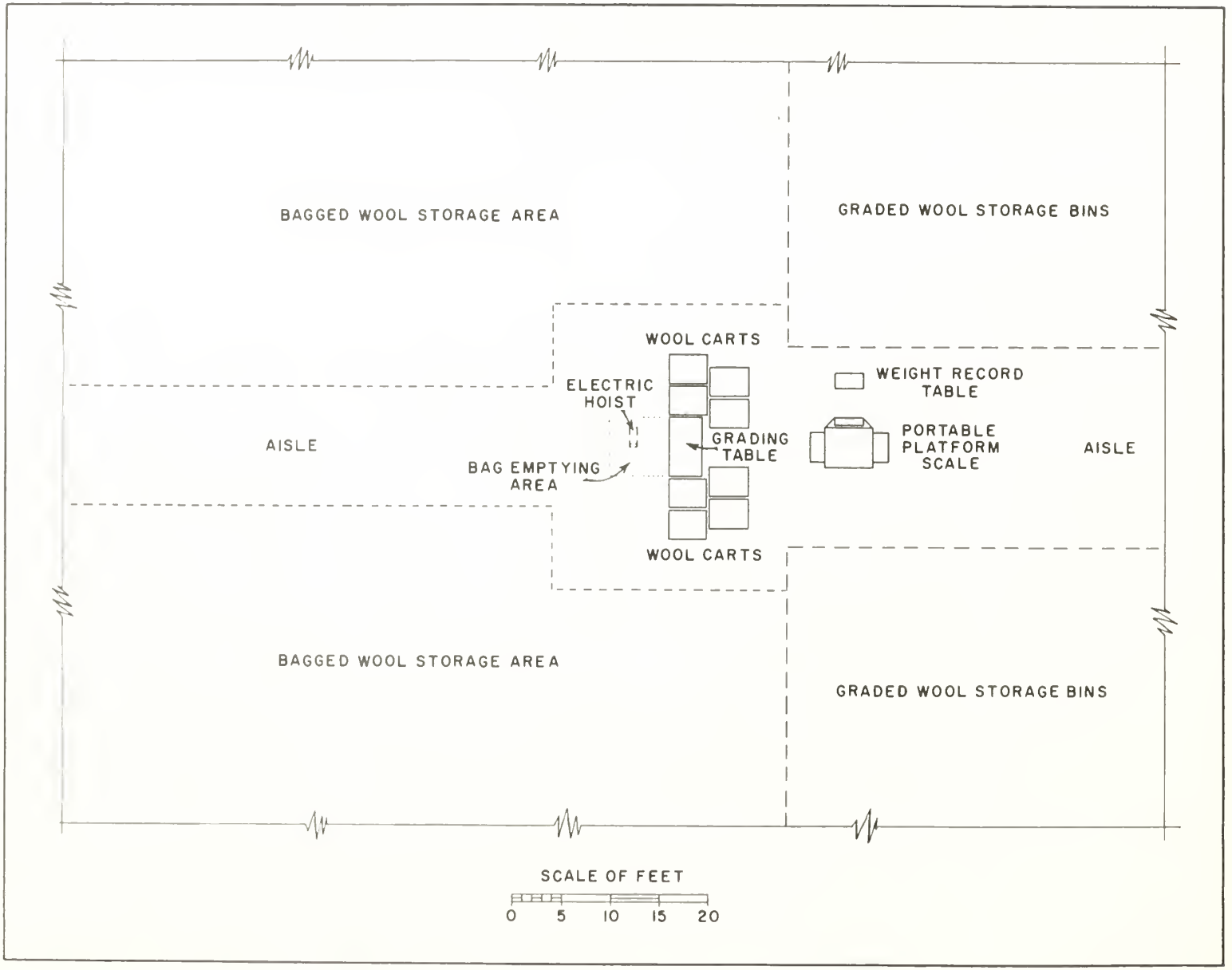

Figure 12.--Layout for grading wool using an electric hoist and wool carts.

- A platform scale;

- Wool carts for transporting graded wool to the graded wool storage bins.

This combination of equipment is used for grading consigned wool by the following methods: Seven-worker, handtruck, hoist, and wool-cart; six-worker, handtruck, hoist, and wool-cart; and five-worker, handtruck, hoist, and wool-cart. In grading warehouse-owned wool, the same combination of equipment (except that a platform scale is not required) is used for the six-worker, handtruck, hoist, and wool-cart method and the six-worker, clamp-truck, hoist, and wool-cart method.

The electric hoist is located about 3 feet from the table, opposite the grader. Adequate space is provided on that side of the table for the bags of wool to be unloaded from the handtruck or clamp truck, and the fleeces to be emptied onto the floor and then placed on the grading table. The area is approximately 8 feet by 6 feet, or 48 square feet.

The wool carts are grouped around the other three sides of the grading table, convenient to the grader (fig. 13). Eight carts are usually all that the grader needs. The grading table is 3 feet 4 inches by 6 feet, and this number of wool carts can be grouped around the three sides so that the grader need not toss a fleece more than about 6 feet. The wool carts are not in front of the grader, because this reduces the work area needed for handling and emptying wool bags.

Wool-cart transporting workers may move two carts per trip if, for any reason, they are not keeping abreast of the workload. Since two workers usually handle the wool carts, a minimum of 12 carts is indicated. Fourteen wool carts will take care of maximum needs and allow one or more carts to be out of service for repair.

The area around the grading table for wool carts must be adequate for the carts in use, extra carts, and maneuvering space for the workers. This area, extending from the grading table to the platform scale, is about 30 feet wide (about 12 feet on each side of the grading worker) and about 15 feet deep, or 450 square feet.

The scale platform is about 4 by 5 feet. The scale is a dial-type for ease and speed in reading the weight. A small worktable nearby is used for recording the weight data and to store the weight records. The weighing station is in the aisle between the graded wool bins. The carts are weighed en route to the bins with minimum travel.

The total area required for grading consigned wool in this layout is approximately 30 by 30 feet, or 900 square feet of floor space.

Layout Using Conveyor and Wool Carts

The items of equipment involved with this layout (fig. 14) are:

- A transporting vehicle--a 2-wheel handtruck or a clamp truck;

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Figure 13.--Wool carts grouped around a grading table.

- A 10-foot conveyor leading to the grading table;
- A grading table;
- A platform scale (not required when this equipment arrangement is used for grading warehouse-owned wool);

Wool carts for transporting graded wool to the graded wool storage bins.

This combination of equipment is used for grading consigned wool by the five-worker, clamp-truck, conveyor, and wool-cart method.

The conveyor carrying fleeces to the grader is on the opposite side of the grading table from the grader. Its end reaches the center of that side of the table and extends into the grading table approximately 12 inches. This permits the wool fleeces to leave the conveyor at a point convenient for the grader, and prevents fleeces from falling off the table. The opposite end of

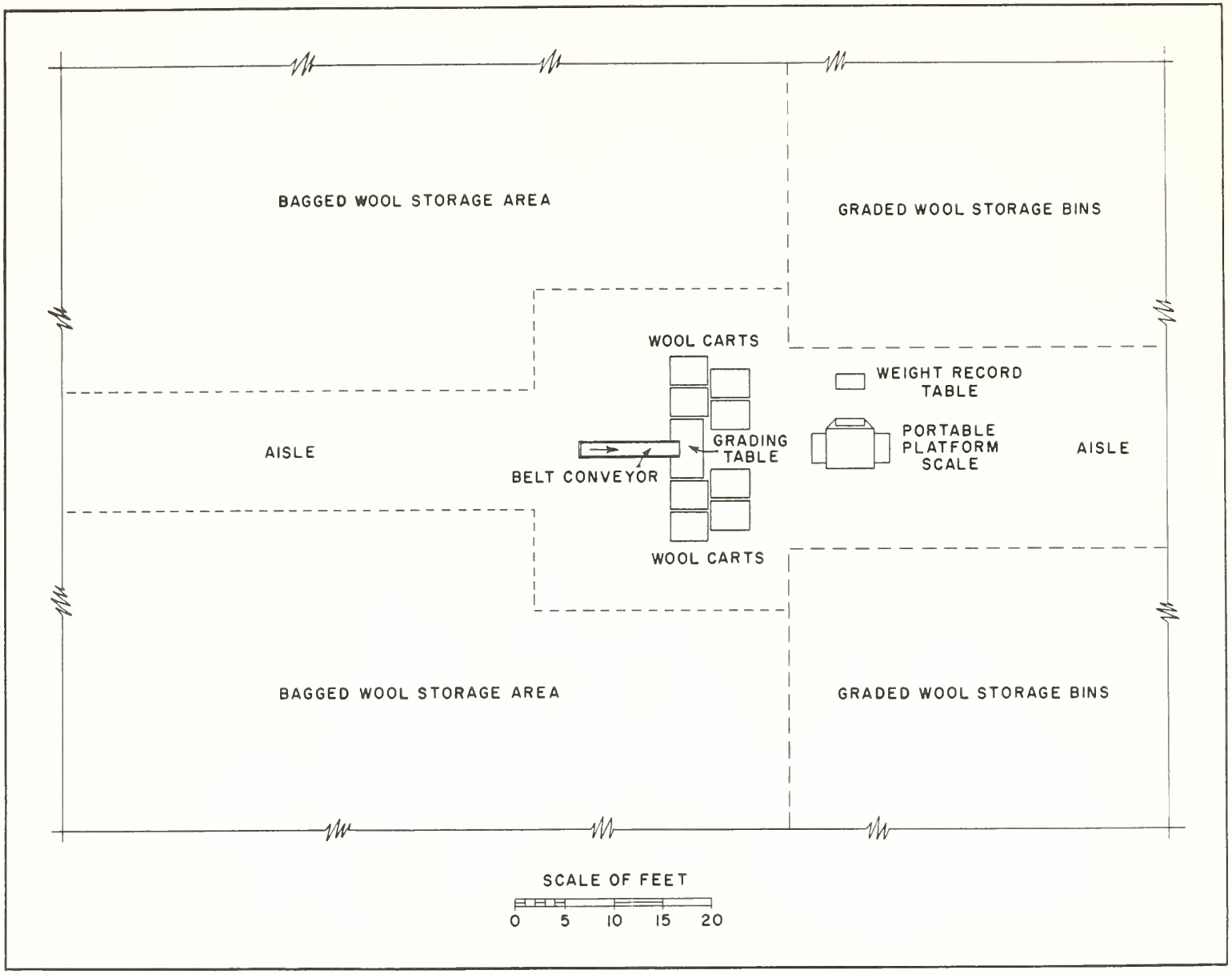

Figure 14.--Layout for grading wool, using a conveyor and wool carts.

the conveyor is about 12 inches below floor level, and has a hopper around the end for rapid and easy emptying of fleeces onto the conveyor. The conveyor is about 10 feet long and about 2 feet wide.

The grading table is equipped with a knee switch, so that the grader can control the conveyor and regulate the arrival of fleeces.

Adequate space is provided around the conveyor for workers to handle bags and maneuver the transporting vehicle. An area about 12 by 15 feet (180 square feet) is suggested.

The arrangement of the wool carts on three sides of the table and the location of the platform scale are the same as those of the first layout. The total area required for grading consigned wool in this layout is approximately 30 by 40 feet, or 1,200 square feet of floor space.

Layout Using a Conveyor System

The items of equipment involved with this layout (fig. 15) are:

- A transporting vehicle--a 2-wheel handtruck or a clamp truck;
- A 10-foot conveyor leading to the grading table;
- A system of seven conveyors averaging approximately 35 feet in length extending from the grading table to a row of graded wool storage bins.

This combination of equipment is used for grading warehouse-owned wool by both the four-worker and the three-worker clamp-truck and conveyor methods.

The conveyor leading to the table is on the left of the wool grader. This location is suggested because the location already described will be occupied by the system of conveyors leading from the table to the bins. Otherwise, the conveyor functions in the same manner.

Warehouse-owned wool is not weighed, so a series of conveyors eliminates the labor of transporting wool to storage bins.

A system of seven conveyors is suggested. A semistacking arrangement enables the grader to easily toss a fleece onto any one of the seven conveyors. Each conveyor slopes upward and extends approximately 4 feet into the storage bin. This permits the bins to fill properly and minimizes congestion of fleeces next to the conveyor. Each conveyor is anchored to the 12-foot bin wall. The width of each conveyor is 2 feet. The grading table is about 16 feet from the closest storage bin wall. Thus the lengths of the conveyors vary; one should be 24 feet long, two should be 28 feet, two should be 33 feet, and two should be 42 feet.

This layout involves an area approximately 30 feet by 50 feet, or 1,500 square feet. However, only about 20 by 30 feet, or 600 square feet, is actually occupied by wool-grading equipment. The remaining area, next to the bins and beneath the conveyors, is available for moving bags of wool fleeces to and from storage area.

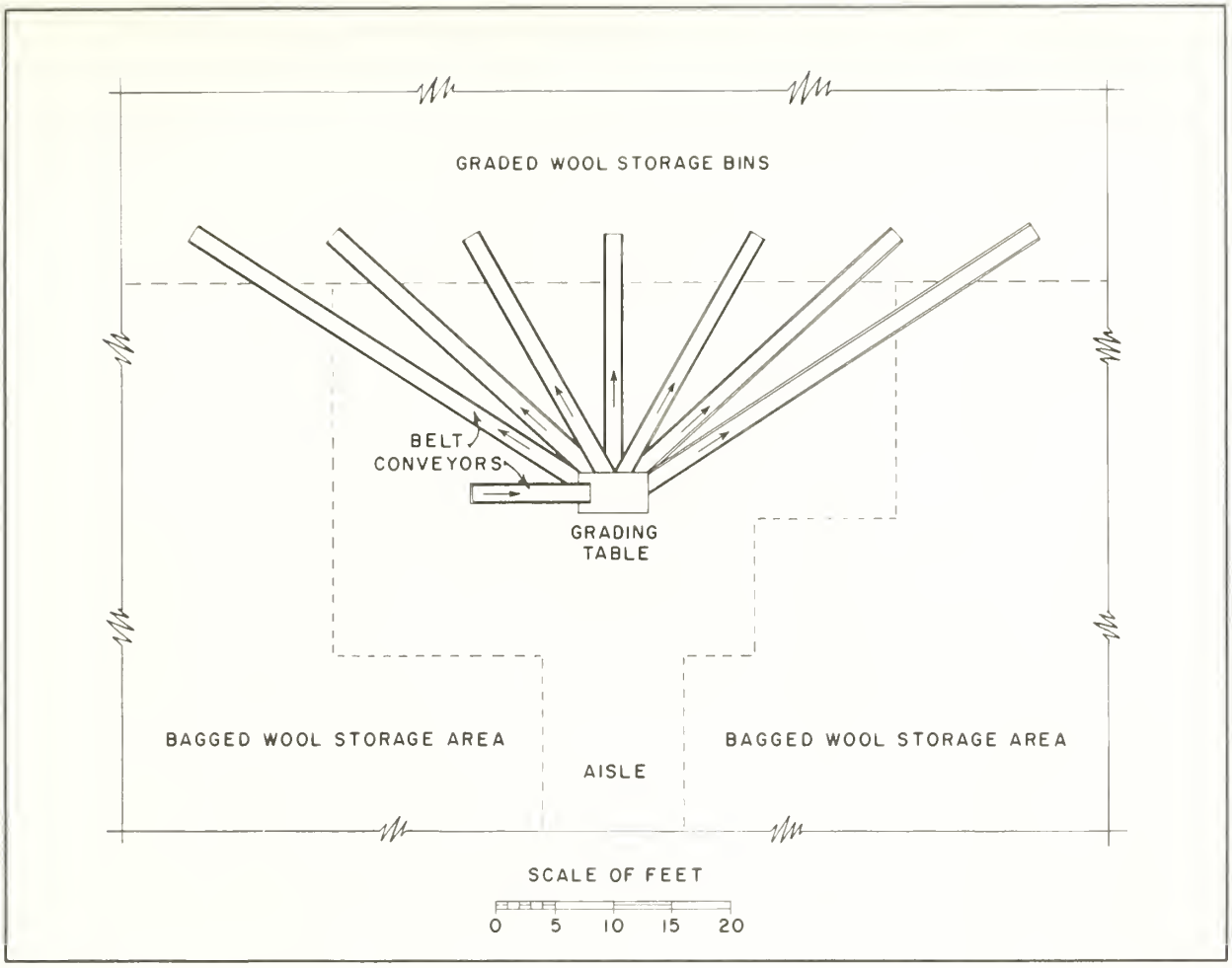

Figure 15.--Layout for grading wool using a conveyor system.

APPENDIX

Five tables have been developed as aids in comparing labor and equipment requirements and costs. Table 13 shows the ownership and operating costs for each item of equipment used in the various methods employed in grading consigned and warehouse-owned wool. Table 14 shows the productive labor requirements for transporting 1,000 pounds of bagged wool various distances with a handtruck and a clamp truck. Table 15 shows the productive labor requirements for transporting 1,000 pounds of consigned and warehouse-owned wool various distances with wool carts. The productive, unproductive, and total labor requirements for grading 1,000 pounds of consigned and warehouse-owned wool, by method, operation, and time item, are shown in tables 16 and 17.

Table 13.--Ownership and operating costs of equipment for a wool warehouse grading 1 million pounds annually

Operation	Amount of equipment	Capacity	Initial cost	Expected life	Ownership cost				Operating cost			Total annual cost	Total annual usage	Cost per hour of use	Cost per 1,000 pounds
					Depreciation	Interest	Insurance and taxes	Total	Fuel and power	Maintenance	Total				
			Dollars	Years	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Hours	Dollars	Dollars
CONSIGNED WOOL															
Seven-worker, handtruck, hoist, and wool-cart method:															
2-wheel handtruck	1	--	60	15	4.00	1.80	2.40	8.20	--	0.31	0.31	8.51	440	0.0193	0.0085
Electric hoist	1	1/2-HP	325	10	32.50	9.75	13.00	55.25	2.97	2.50	5.47	60.72	440	.1380	.0607
Grading table	1	40" x 72"	25	10	2.50	.75	1.00	4.25	--	.19	.19	4.44	440	.0101	.0044
Platform scale	1	48" x 60"	1,400	15	93.33	42.00	56.00	191.33	--	9.80	9.80	201.13	600	.3352	.1475
Wool carts	18	36"x48"x30"	720	8	90.00	21.60	28.80	140.40	--	6.93	6.93	147.33	440	.3348	.1473
Six-worker, handtruck, hoist, and wool-cart method: (same as seven-worker method above)															
Five-worker, handtruck, hoist, and wool-cart method:															
2-wheel handtruck	1	--	60	15	4.00	1.80	2.40	8.20	--	.34	.34	8.54	490	.0174	.0085
Electric hoist	1	1/2-HP	325	10	32.50	9.75	13.00	55.25	2.97	2.80	5.77	61.02	490	.1245	.0610
Grading table	1	40" x 72"	25	10	2.50	.75	1.00	4.25	--	.22	.22	4.47	490	.0091	.0045
Wool carts	18	36"x48"x30"	720	8	90.00	21.60	28.80	140.40	--	7.74	7.74	148.14	490	.3023	.1481
Platform scale	1	48" x 60"	1,400	15	93.33	42.00	56.00	191.33	--	10.64	10.64	201.97	650	.3107	.1522
Five-worker, clamp-truck, conveyor, and wool-cart method:															
Clamp truck	1	2,000-lb.	4,600	8	575.00	138.00	184.00	897.00	162.50	149.50	312.00	1,209.00	650	1.8600	.2046
Belt conveyor	1	15" x 10'	625	15	41.67	18.75	25.00	85.42	5.67	3.08	8.75	94.17	420	.2242	.0942
Grading table	1	40" x 72"	25	10	2.50	.75	1.00	4.25	--	.19	.19	4.44	420	.0106	.0044
Wool carts	14	36"x48"x30"	560	8	70.00	16.80	22.40	109.20	--	5.14	5.14	114.35	420	.2723	.1144
Portable platform scale	1	48" x 60"	2,000	15	133.33	60.00	80.00	273.33	--	19.87	19.87	293.20	850	.3449	.1449
WAREHOUSE-OWNED WOOL															
Six-worker, clamp-truck, hoist, and wool-cart method:															
Clamp truck	1	2,000-lb.	4,600	8	575.00	138.00	184.00	897.00	162.50	149.50	312.00	1,209.00	650	1.8600	.2418
Electric hoist	1	1/2-HP	325	10	32.50	9.75	13.00	55.25	2.43	2.05	4.48	59.73	360	.1659	.0597
Grading table	1	40" x 72"	25	10	2.50	.75	1.00	4.25	--	.16	.16	4.41	360	.0123	.0044
Wool carts	18	36"x48"x30"	720	8	90.00	21.60	28.80	140.40	--	5.67	5.67	146.07	360	.4058	.1461

Continued

Table 13.--Ownership and operating costs of equipment for a wool warehouse grading 1 million pounds annually, continued

Operation	Amount of equipment	Capacity	Initial cost	Expected life	Ownership cost				Operating cost			Total annual cost	Total annual usage	Cost per hour of use	Cost per 1,000 pounds
					Depreciation	Interest	Insurance and taxes	Total	Fuel and power	Maintenance	Total				
			Dollars	Years	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Hours	Dollars	Dollars
WAREHOUSE-OWNED WOOL, continued															
Six-worker, handtruck, hoist, and wool-cart method:															
Electric hoist	1	1/2-HP	325	10	32.50	9.75	13.00	55.25	2.43	2.05	4.48	59.73	360	0.1659	0.0597
2-wheel handtruck	1	--	60	15	4.00	1.80	2.40	8.20	--	.25	.25	8.45	360	.0235	.0085
Grading table	1	40" x 72"	25	10	2.50	.75	1.00	4.25	--	.16	.16	4.41	360	.0123	.0044
Wool carts	18	36"x48"x30"	720	8	90.00	21.60	28.80	140.40	--	5.67	5.67	146.07	360	.4058	.1461
Four-worker, clamp-truck, and conveyor method:															
Clamp truck	1	2,000-lb.	4,600	8	575.00	138.00	184.00	897.00	162.50	149.50	312.00	1,209.00	650	1.8600	.2418
Belt conveyor	1	15" x 10'	625	15	41.67	18.75	25.00	85.42	4.86	2.62	7.48	92.90	360	.2581	.0929
Grading table	1	40" x 72"	25	10	2.50	.75	1.00	4.25	--	.16	.16	4.41	360	.0123	.0044
Belt conveyor	7	15" x 35'	6,500	15	433.33	195.00	260.00	888.33	68.04	27.30	95.34	983.67	360	2.7324	.9837
Three-worker, clamp-truck, and conveyor method: (same as four-worker method above)															

Table 14.--Average productive labor requirements for transporting 1,000 pounds of bagged wool, by type of transporting equipment

Distance	2-wheel handtruck			Clamp truck		
	Base time	Fatigue and personal allowance	Productive time	Base time	Fatigue and personal allowance	Productive time
Feet	Man-hours	Percent	Man-hours	Man-hours	Percent	Man-hours
10	0.0153	15	0.0176	0.0111	10	0.0122
20	.0250	15	.0288	.0181	10	.0199
30	.0333	15	.0383	.0229	10	.0252
40	.0403	15	.0463	.0264	10	.0290
50	.0472	15	.0543	.0292	10	.0321
60	.0541	15	.0622	.0313	10	.0344
70	.0597	15	.0687	.0334	10	.0367
80	.0653	15	.0751	.0348	10	.0383
90	.0708	15	.0814	.0361	10	.0397
100	.0750	15	.0863	.0375	10	.0413
110	.0791	15	.0910	.0389	10	.0428
120	.0833	15	.0958	.0396	10	.0436
130	.0875	15	.1006	.0403	10	.0443
140	.0916	15	.1053	.0410	10	.0451
150	.0958	15	.1102	.0417	10	.0459

Table 15.--Average productive labor requirements for transporting 1,000 pounds of consigned and warehouse-owned graded wool in carts

Distance moved	Consigned wool			Warehouse-owned wool		
	Base time	Fatigue and personal allowance	Productive time	Base time	Fatigue and personal allowance	Productive time
Feet	Man-hours	Percent	Man-hours	Man-hours	Percent	Man-hours
10	0.0300	15	0.0345	0.0105	15	0.0121
20	.0500	15	.0575	.0175	15	.0201
30	.0633	15	.0728	.0222	15	.0255
40	.0750	15	.0863	.0263	15	.0302
50	.0867	15	.0997	.0303	15	.0348
60	.0983	15	.1130	.0344	15	.0396
70	.1100	15	.1265	.0385	15	.0443
80	.1217	15	.1400	.0426	15	.0490
90	.1333	15	.1533	.0467	15	.0537
100	.1450	15	.1668	.0508	15	.0584
110	.1567	15	.1802	.0548	15	.0630
120	.1683	15	.1935	.0589	15	.0677
130	.1800	15	.2070	.0630	15	.0725
140	.1933	15	.2223	.0677	15	.0779
150	.2067	15	.2377	.0723	15	.0831

Table 16.--Labor requirements per 1,000 pounds for grading consigned wool in a warehouse grading 1 million pounds annually

Operation	Productive time			Unproductive time	Total labor requirements
	Base time	Fatigue and personal allowance	Total		
	Man-hours	Man-hours	Man-hours	Man-hours	Man-hours
Seven-worker, handtruck, hoist, and wool-cart method:					
Transport bagged wool from storage area to grading area (1 worker):					
Move empty 2-wheel handtruck from grading area to bagged wool storage area (average distance 70 feet)	0.06	0.01	0.07	--	--
Load bag on handtruck	.04	1/	.04	--	--
Transport bag to grading area (average distance 70 feet)	.06	.01	.07	--	--
Unload bag	.02	1/	.02	--	--
Wait time	--	--	--	0.24	--
Subtotal	.18	.02	.20	.24	0.44
Empty wool bags and place fleeces on grading table (2 workers):					
Cut tie and open one end of bag	.04	1/	.04	--	--
Lower hoist, attach hoist clamps, and raise bag	.07	.01	.08	--	--
Empty fleeces onto floor	.09	.01	.10	--	--
Lower hoist, detach bag, raise hoist, fold and stack empty bags	.08	.01	.09	--	--
Pick up fleeces and place on table	.24	.04	.28	--	--
Clean area after each owner's lot	.02	1/	.02	--	--
Wait time	--	--	--	.27	--
Subtotal	.54	.07	.61	.27	.88
Grade fleeces (1 worker):					
Pick up, grade, and toss fleeces into wool carts	.31	.05	.36	--	--
Record data on tally sheet	.05	.01	.06	--	--
Clean area after each owner's lot	.02	1/	.02	--	--
Wait time	--	--	--	--	--
Subtotal	.38	.06	.44	--	.44

See footnotes on page 46.

continued

Table 16.--Labor requirements per 1,000 pounds for grading consigned wool in a warehouse grading 1 million pounds annually, continued

Operation	Productive time			Unproductive time	Total labor requirement
	Base time	Fatigue and personal allowance	Total		
	Man-hours	Man-hours	Man-hours	Man-hours	Man-hours
Seven-worker, handtruck, hoist, and wool-cart method, continued:					
Transport graded wool from grading area to storage bins (3 workers):					
Move loaded carts from grading area to scale (average distance 35 feet)	0.07	0.01	0.08	--	--
Weigh and record data	.16	.02	.18	--	--
Move carts from scale to storage bins (average distance 50 feet)	.09	.01	.10	--	--
Empty fleeces into bins	.21	.03	.24	--	--
Return empty carts to grading area (average distance 65 feet)	.11	.01	.12	--	--
Wait time	--	--	--	.60	--
Subtotal	.64	.08	.72	.60	1.32
Total	1.74	.23	1.97	1.11	3.08
Six-worker, handtruck, hoist, and wool-cart method:					
Transport bagged wool from storage area to grading area (1 worker):					
Move empty 2-wheel handtruck from grading area to bagged wool storage area (average distance 70 feet)	.06	.01	.07	--	--
Load bag on handtruck	.04	1/	.04	--	--
Transport bag to grading area	.06	.01	.07	--	--
Unload bag	.02	1/	.02	--	--
Wait time	--	--	--	.24	--
Subtotal	.18	.02	.20	.24	.44

See footnotes on page 46.

continued

Table 16.--Labor requirements per 1,000 pounds for grading consigned wool in a warehouse grading 1 million pounds annually, continued

Operation	Productive time			Unproductive time	Total labor requirements
	Base time	Fatigue and personal allowance	Total		
	Man-hours	Man-hours	Man-hours	Man-hours	Man-hours
Six-worker, handtruck, hoist, and wool cart-method, continued:					
Empty wool bags and place fleeces on grading table (2 workers):					
Cut tie and open one end of bag	0.04	1/	0.04	--	--
Lower hoist, attach hoist clamps, and raise bag	.07	0.01	.08	--	--
Empty fleeces onto floor	.09	.01	.10	--	--
Lower hoist, detach bag, raise hoist, fold and stack empty bag	.08	.01	.09	--	--
Pick up fleeces and place on table	.24	.04	.28	--	--
Clean area after each owner's lot	.02	1/	.02	--	--
Wait time	--	--	--	0.27	--
Subtotal	.54	.07	.61	.27	0.88
Grade wool fleeces (1 worker):					
Pick up, grade, and toss fleeces into carts	.31	.05	.36	--	--
Record data on tally sheet	.05	.01	.06	--	--
Clean area after each owner's lot	.02	1/	.02	--	--
Wait time	--	--	--	--	--
Subtotal	.38	.06	.44	--	.44
Transport graded wool from grading area to storage bins (2 workers):					
Move loaded carts from grading area to scale (average distance 35 feet)	.07	.01	.08	--	--
Weigh and record data	.16	.02	.18	--	--
Move carts from scale to storage bins (average distance 50 feet)	.09	.01	.10	--	--

See footnotes on page 46.

continued

Table 16.--Labor requirements per 1,000 pounds for grading consigned wool in a warehouse grading 1 million pounds annually, continued

Operation	Productive time			Unproductive time	Total labor requirements
	Base time	Fatigue and personal allowance	Total		
	Man-hours	Man-hours	Man-hours	Man-hours	Man-hours
Six-worker, handtruck, hoist, and wool-cart method, continued:					
Transport graded wool from grading area to storage bins (2 workers), continued:					
Empty fleeces into bins	0.21	0.03	0.24	--	--
Return empty carts to grading area (average distance 65 feet)	.11	.01	.12	--	--
Wait time	--	--	--	0.16	--
Subtotal	.64	.08	.72	.16	0.88
Total	1.74	.23	1.97	.67	2.64
Five-worker, handtruck, hoist, and wool-cart method:					
Transport bagged wool from storage area to grading area (1 worker):					
Move empty 2-wheel handtruck from grading area to bagged wool storage area (average distance 70 feet)	.06	.01	.07	--	--
Load bag on handtruck	.04	1/	.04	--	--
Transport bag to grading area (average distance 70 feet)	.06	.01	.07	--	--
Unload bag	.02	1/	.02	--	--
Cut tie and open one end of bag	.04	1/	.04	--	--
Lower hoist, attach hoist clamps, and raise bag	.07	.01	.08	--	--
Wait time	--	--	--	.17	--
Subtotal	.29	.03	.32	.17	.49

See footnotes on page 46.

continued

Table 16.--Labor requirements per 1,000 pounds for grading consigned wool in a warehouse grading 1 million pounds annually, continued

Operation	Productive time			Unproductive time	Total labor requirements
	Base time	Fatigue and personal allowance	Total		
	Man-hours	Man-hours	Man-hours	Man-hours	Man-hours
Five-worker, handtruck, hoist, and wool-cart method, continued:					
Empty wool bags and place fleeces on grading table (1 worker):					
Empty fleeces onto floor	0.09	0.01	0.10	--	--
Lower hoist, detach bag, raise hoist, fold and stack empty bag	.08	.01	.09	--	--
Pick up fleeces and place on table	.24	.04	.28	--	--
Clean area after each owner's lot	.02	1/	.02	--	--
Wait time	--	--	--	--	--
Subtotal	.43	.06	.49	--	0.49
Grade fleeces (1 worker):					
Pick up, grade, and toss fleeces into carts	.31	.05	.36	--	--
Record data on tally sheet	.05	.01	.06	--	--
Clean area after each owner's lot	.02	1/	.02	--	--
Wait time	--	--	--	0.05	--
Subtotal	.38	.06	.44	.05	.49
Transport wool from grading area to bins (2 workers):					
Move carts from grading area to scale (average distance 35 feet)	.07	.01	.08	--	--
Weigh and record data	.16	.02	.18	--	--
Move carts from scale to storage bins (average distance 50 feet)	.09	.01	.10	--	--
Empty fleeces into bins	.21	.03	.24	--	--
Return empty carts to grading area (average distance 65 feet)	.11	.01	.12	--	--
Wait time	--	--	--	.26	--
Subtotal	.64	.08	.72	.26	.98
Total	1.74	.23	1.97	.48	2.45

See footnotes on page 46.

continued

Table 16.--Labor requirements per 1,000 pounds for grading consigned wool in a warehouse grading 1 million pounds annually, continued

Operation	Productive time			Unproductive time	Total labor requirements
	Base time	Fatigue and personal allowance	Total		
	Man-hours	Man-hours	Man-hours	Man-hours	Man-hours
Five-worker, clamp-truck, conveyor, and wool-cart method:					
Transport bagged wool from storage area to grading areas (1 worker):					
Drive empty clamp truck from grading area to bagged wool storage area (average distance 50 feet)	0.03	1/	0.03	--	--
Position 2 bags and pick up for transport	.04	1/	.04	--	--
Drive truck to conveyor in grading area (average distance 50 feet)	.03	1/	.03	--	--
Unload bags	.01	1/	.01	--	--
Wait time	--	--	--	2/	--
Subtotal	.11	--	.11	--	0.11
Empty wool bags and place fleeces on conveyor (1 worker):					
Open seam on one side of bag	.05	1/	.05	--	--
Place fleeces on conveyor	.11	0.01	.12	--	--
Fold and stack empty bag	.05	1/	.05	--	--
Clean area after each owner's lot	.04	1/	.04	--	--
Wait time	--	--	--	0.16	--
Subtotal	.25	.01	.26	.16	.42
Grade fleeces (1 worker):					
Pick up, grade, and toss fleeces into carts	.31	.05	.36	--	--
Record data on tally sheet	.05	.01	.06	--	--
Wait time	--	--	--	--	--
Subtotal	.36	.06	.42	--	.42

See footnotes on page 46.

continued

Table 16.--Labor requirements per 1,000 pounds for grading consigned wool in a warehouse grading 1 million pounds annually, continued

Operation	Productive time			Unproductive time	Total labor requirements
	Base time	Fatigue and personal allowance	Total		
	Man-hours	Man-hours	Man-hours	Man-hours	Man-hours
Five-worker, clamp-truck, conveyor, and wool-cart method, continued:					
Transport wool from grading area to bins (2 workers):					
Move loaded wool carts from grading area to scales (average distance 15 feet)	0.05	1/	0.05	--	--
Weigh and record data	.16	0.02	.18	--	--
Move carts from scale to storage bins (average distance 50 feet)	.09	.01	.10	--	--
Empty fleeces from carts into bins	.21	.03	.24	--	--
Return empty carts to grading area (average distance 60 feet)	.10	.01	.11	--	--
Wait time	--	--	--	.16	--
Subtotal	.61	.07	.68	.16	.84
Total	1.33	.14	1.47	.32	1.79

1/ Less than 0.01 man-hour.
2/ This worker is charged on an actual use basis and no wait time is involved.

Table 17.--Labor requirements per 1,000 pounds for grading warehouse-owned wool in a warehouse grading 1 million pounds annually

Operation	Productive time			Unproductive time	Total labor requirements
	Base time	Fatigue and personal allowance	Total		
	Man-hours	Man-hours	Man-hours	Man-hours	Man-hours
Six-worker, handtruck, hoist, and wool-cart method:					
Transport bagged wool from storage area to grading area (1 worker):					
Move empty 2-wheel handtruck from grading area to bagged-wool storage area (average distance 70 feet)	0.06	0.01	0.07	--	--
Load bag in handtruck	.04	1/	.04	--	--
Transport bag to grading area (average distance 70 feet)	.06	.01	.07	--	--
Unload bag	.02	1/	.02	--	--
Wait time	--	--	--	0.16	--
Subtotal	.18	.02	.20	.16	0.36
Empty bags and place fleeces on grading table (2 workers):					
Cut tie and open one end of bag	.04	1/	.04	--	--
Lower hoist, attach hoist clamps, and raise bag	.07	.01	.08	--	--
Empty fleeces onto floor	.09	.01	.10	--	--
Lower hoist, detach bag, raise hoist, fold and stack empty bag	.08	.01	.09	--	--
Pick up fleeces and place on table	.24	.04	.28	--	--
Wait time	--	--	--	.13	--
Subtotal	.52	.07	.59	.13	.72
Grade fleeces (1 worker):					
Pick up, grade, and toss fleeces into carts	.31	.05	.36	--	--
Wait time	--	--	--	--	--
Subtotal	.31	.05	.36	--	.36

See footnotes on page 51.

continued

Table 17.--Labor requirements per 1,000 pounds for grading warehouse-owned wool in a warehouse grading 1 million pounds annually, continued

Operation	Productive time			Unproductive time	Total labor requirements
	Base time	Fatigue and personal allowance	Total		
	Man-hours	Man-hours	Man-hours	Man-hours	Man-hours
Six-worker, handtruck, hoist, and wool-cart method:					
Transport wool from grading area to bins (2 workers):					
Move loaded wool carts from grading area to storage bins (average distance 65 feet)	0.04	1/	0.04	--	--
Empty fleeces from carts into bins	.21	0.03	.24	--	--
Return empty carts to grading area (average distance 65 feet)	.04	1/	.04	--	--
Wait time	--	--	--	0.40	--
Subtotal	.29	.03	.32	.40	0.72
Total	1.30	.17	1.47	.69	2.16
Six-worker, clamp-truck, hoist, and wool-cart method:					
Transport bagged wool from storage area to grading area (1 worker):					
Drive empty clamp truck from grading area to storage area (average distance 70 feet)	.04	1/	.04	--	--
Position 2 bags and pick up for transport	.04	1/	.04	--	--
Drive truck to grading area (average distance 70 feet)	.04	1/	.04	--	--
Unload bags	.01	1/	.01	--	--
Wait time	--	--	--	2/	--
Subtotal	.13	--	.13	--	.13
Empty wool bags and place fleece on grading table (2 workers):					
Cut tie and open one end of bag	.04	1/	.04	--	--
Lower hoist, attach hoist clamps, and raise bag	.07	.01	.08	--	--
Empty fleeces onto floor	.09	.01	.10	--	--
Lower hoist, detach bag, raise hoist, fold and stack empty bag	.08	.01	.09	--	--

See footnotes on page 51.

continued

Table 17.--Labor requirements per 1,000 pounds for grading warehouse-owned wool in a warehouse grading 1 million pounds annually, continued

Operation	Productive time			Unproductive time	Total labor requirements
	Base time	Fatigue and personal allowance	Total		
	Man-hours	Man-hours	Man-hours	Man-hours	Man-hours
Six-worker, clamp-truck, hoist, and wool-cart method, continued:					
Empty wool bags and place fleeces on grading table (2 workers), continued:					
Pick up fleeces and place on table	0.24	0.04	0.28	--	--
Wait time	--	--	--	0.13	--
Subtotal	.52	.07	.59	.13	0.72
Grade fleeces (1 worker):					
Pick up, grade, and toss fleeces into carts	.31	.05	.36	--	--
Wait time	--	--	--	--	--
Subtotal	.31	.05	.36	--	.36
Transport wool from grading area to bins (2 workers):					
Move carts from grading area to storage bins (average distance 65 feet)	.04	1/	.04	--	--
Empty fleeces into bins	.21	.03	.24	--	--
Return empty carts to grading area (average distance 65 feet)	.04	1/	.04	--	--
Wait time	--	--	--	.40	--
Subtotal	.29	.03	.32	.40	.72
Total	1.25	.15	1.40	.53	1.93

See footnotes on page 51.

continued

Table 17.--Labor requirements per 1,000 pounds for grading warehouse-owned wool in a warehouse grading 1 million pounds annually, continued

Operation	Productive time			Unproductive time	Total labor requirements
	Base time	Fatigue and personal allowance	Total		
	Man-hours	Man-hours	Man-hours	Man-hours	Man-hours
Four-worker, clamp-truck, and conveyor method:					
Transport bagged wool from storage to grading area (1 worker):					
Drive empty clamp truck from grading area to bagged wool storage area (average distance 100 feet)	0.04	1/	0.04	--	--
Position 2 bags and pick up for transport	.04	1/	.04	--	--
Drive truck to conveyor in grading area (average distance 100 feet)	.04	1/	.04	--	--
Unload bags	.01	1/	.01	--	--
Wait time	--	--	--	2/	--
Subtotal	.13	--	.13	--	0.13
Empty bags and place fleeces on grading table conveyor (2 workers):					
Open seam on one side of bag	.05	1/	.05	--	--
Place fleeces on conveyor	.11	0.01	.12	--	--
Fold and stack empty bag	.05	1/	.05	--	--
Wait time	--	--	--	0.50	--
Subtotal	.21	.01	.22	.50	.72
Grade fleeces (1 worker):					
Pick up, grade, and toss fleeces onto conveyor	.31	.05	.36	--	--
Wait time	--	--	--	--	--
Subtotal	.31	.05	.36	--	.36
Transport wool from grading area to bins:					
(No labor required)	--	--	--	--	--
Total	.65	.06	.71	.50	1.21

See footnotes on page 51.

continued

Table 17.--Labor requirements per 1,000 pounds for grading warehouse-owned wool in a warehouse grading 1 million pounds annually, continued

Operation	Productive time			Unproductive time	Total labor requirements
	Base time	Fatigue and personal allowance	Total		
	Man-hours	Man-hours	Man-hours	Man-hours	Man-hours
Three-worker, clamp-truck, and conveyor method:					
Transport bagged wool from storage area to grading area (1 worker):					
Drive empty truck from grading area to storage area (average distance 75 feet)	0.04	1/	0.04	--	--
Position 2 bags and pick up for transport	.04	1/	.04	--	--
Drive loaded truck to conveyor in grading area (average distance 75 feet)	.04	1/	.04	--	--
Unload bags	.01	1/	.01	--	--
Wait time	--	--	--	2/	--
Subtotal	.13	--	.13	--	0.13
Empty bags and place fleeces on grading table (1 worker):					
Open seam on one side of bag	.05	1/	.05	--	--
Place fleeces on conveyor	.11	0.01	.12	--	--
Fold and stack empty bag	.05	1/	.05	--	--
Wait time	--	--	--	0.14	--
Subtotal	.21	.01	.22	.14	.36
Grade fleeces (1 worker):					
Pick up, grade, and toss fleeces onto conveyor	.31	.05	.36	--	--
Wait time	--	--	--	--	--
Subtotal	.31	.05	.36	--	.36
Transport wool from grading area to bins:					
(No labor required)	--	--	--	--	--
Total	.65	.06	.71	.14	.85

1/ Less than 0.01 man-hour.
2/ This worker is charged on an actual-use basis and no wait time is involved.

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